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PATENT SPECIFICATION

804,592

Inventor:—GILBERT ASHTON PLUMMER.

Date of filing Complete Specification: Nov. 24, 1954.

Application Date: May 26, 1954. No. 15587/54.

Complete Specification Published: Nov. 19, 1958.

Index at Acceptance:—**Classes 64(3),** S6; **83(2)**, A158; **and 83(4)**, E7F.

International Classification:—B23k, p. F25h.

COMPLETE SPECIFICATION.

Improvements in or relating to Heat Exchangers and Tubes therefor.

We, JOHN THOMPSON WATER TUBE BOILERS LIMITED, a Company registered under the laws of Great Britain, of Ettingshall Engineering Works, Wolverhampton, in the County of Stafford, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention has reference to heat exchangers and tubes therefor.

The heat exchanger to which the present invention relates is of the kind comprising a tubular element through which one fluid is passed, and over which another fluid is passed so that heat transfer takes place from one fluid to the other through the wall of the tube. In such heat exchangers it sometimes happens that the tube leaks and the fluids mix.

It is an object of the present invention to provide a tube for heat exchangers in which the possibility of fluid leaking from within the tube to outside the tube or vice versa is substantially reduced or eliminated.

According to the present invention there is provided in a heat exchanger a composite tube to be subjected internally and externally to fluids at different temperatures comprising an outer tubular member an inner tubular member spaced therefrom and a heat conducting helical wall extending from one tube to the other so as to provide a passage between the members which communicates with the ends of the tube but which is closed to both said fluids.

According to another aspect of the invention a method of manufacturing a composite tube for use in a heat exchanger comprises fitting around an inner tubular member a helical wall of heat conducting material with the convolutions spaced apart, locating an outer tubular member over the wall and expanding the inner member or drawing down the outer member to seal the wall against the two members.

Embodiments according to the invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Fig. 1 shows a composite tube;

Fig. 2 is a sectional view taken on the line II—II of Fig. 1; and

Fig. 3 shows a heat exchanger comprising a plurality of composite tubes.

The composite tube 1 comprises an inner tubular member 2 and a wall in the form of a strip or wire 3, of heat conducting material such as copper helically wound around the member 2 with the convolutions of the strip spaced apart. This member with the surrounding strip is contained concentrically within an outer tubular member 4 of such internal diameter that there is a fit between the internal surface of the outer member and the outer surface of the strip. Thus a continuous helical passage 5 is formed between the inner and outer members which extends between and communicates with each end of the tubes.

Tubular members as described are built into a heat exchanger in which one fluid is passed through the inner member 2 and another fluid at a different temperature is passed over the outer member 4. A source of inert gas is connected to the helical passage 5 between the inner and outer members. The inert gas is at a pressure different from the pressure of either fluid so that if by any chance there is leakage in one of the members, fluid will pass into or out of the helical passage between the members depending upon the pressure difference and the pressure within the passage between the members will then be changed. This change of

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Price

pressure can be detected by a pressure measuring instrument such as a pressure gauge 6 connected to the passage 5 by a pipe 7. Such change of pressure indicates that a leak has occurred.

As indicated in Fig. 3 composite tubes 1 in the heat exchanger are connected between headers 8, one having an inlet 9 for one fluid and the other an outlet 10 therefor. The other fluid passes, by an inlet 11, into the casing of the heat exchanger where it passes over the outside of the tubes 1 and thence to an outlet 12. The passages 5 between the inner and outer members of the several tubes are connected by a common outlet pipe 13 to a gauge which will indicate the pressure in the passages 5. In operation the pressure of the inert gas in the passages 5 is different from the operating pressure of the fluid in the inner members 2 and over the outer members 4. Hence if there be any leakage from either member 2 or 4 into the passage 5 it will be indicated by a change of pressure in the passage 5.

In an alternative construction the passage 5 is connected to a container having a chemical reagent which will give an indication of leakage as, for example, by change of colour of the reagent.

It will be appreciated that reinforcement of the inner and outer members by the helical strip gives added strength to the tubes.

The tube 1 may conveniently be manufactured by fixing, as by welding, one end of a helical strip or strips to one end of an inner tubular member, and winding the strip or strips on the inner tubular member at the desired pitch. On completion of the winding the other end of the strip is fixed to the other end of the member. The member and strip are then located within the outer member 4 and intimate contact is made between the members and the strip. This may be accomplished either by expanding the inner member or drawing down the outer member. If the inner member is to be expanded this may be accomplished by driving or drawing a mandrel through it or by submitting it to internal pressure generated mechanically by hydraulic power or physically by freezing water contained therein. The expansion is sufficient to ensure adequate and intimate contact between the member and the strip. If the outer member is to be drawn down the members may be passed through a die to reduce the diameter of the outer member, and sufficient reduction is effected to ensure adequate and intimate pressure contact between the members and the strip.

In an alternative method the strip is welded, as by resistance welding, or soldered to both of the members.

In a further method, the helical wall 3 is produced by drawing a metallic sheath, such as copper or aluminium, over the inner member 2, and machining a spiral groove in the external surface of the sheath. This method enables the wall to be made of uniform thickness in a convenient manner and it enables the inner member assembly to be produced to closer tolerances. Alternatively the spiral groove may be formed on the outer member 4 or the spiral may be machined in the outer surface of the member 2 or the internal surface of the member 4 to form an inward projection from the outer member or an outward projection from the inner member.

It will be appreciated, of course, that before the members and strip are operated on, they should be thoroughly cleaned, and the manufacturing operation should be carried out in an inert atmosphere to prevent formation of oxide film on the members and on the strip.

A composite tube as above described would be particularly advantageous as applied to a heat exchanger in which the heating fluid is liquid metal and the heated fluid is water. The one member would probably be of stainless steel, the strip would be of aluminium, copper or other high conductive material, and the other member of alloy or mild steel.

It will be appreciated that a plurality of parallel strips or wires may be located between the members having equal spacings between the strips.

WHAT WE CLAIM IS:—

1. In a heat exchanger a composite tube to be subjected internally and externally to fluids at different temperatures comprising an outer tubular member an inner tubular member spaced therefrom and a heat conducting helical wall extending from one tube to the other so as to provide a passage between the members which communicates with the ends of the tube but which is closed to both said fluids.

2. A composite tube in a heat exchanger according to Claim 1 wherein the helical wall is constituted by a helical strip.

3. A composite tube in a heat exchanger according to Claim 2 wherein the strip is arranged around the inner tubular member in the form of a helix of constant pitch.

4. A composite tube in a heat exchanger according to Claim 1 wherein the helical wall is constituted by an inward projection from the inner wall of the outer tubular member or an outward projection from the outer wall of the inner tubular member.

5. A method of manufacturing a composite tube for use in a heat exchanger comprising fitting around an inner tubular member a helical wall of heat conducting material with the convolutions spaced apart,

locating an outer tubular member over the wall and expanding the inner member or drawing down the outer member to seal the wall against the two members.

6. A method according to Claim 5 in which the inner tubular member is expanded by filling it with water and lowering the temperature until the water freezes.

7. A heat exchanger incorporating a composite tube according to any one of Claims 1 to 4 having means to pass an inert fluid through the helical passage between the inner and outer tubular members.

8. A heat exchanger according to Claim 7 in combination with means to detect a leak of one fluid or the other into the inert fluid.

9. In a heat exchanger a composite tube constructed substantially as herein described with reference to the accompanying drawings.

10. A method of manufacturing a composite tube for use in a heat exchanger substantially as herein described with reference to the accompanying drawings.

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Reference has been directed in pursuance of Section 8 of the Patents Act, 1949, to Specification No. 728,131, and reference has been directed in pursuance of Section 9, subsection (1) of the Patents Act, 1949, to Patent No. 703,081.

PROVISIONAL SPECIFICATION.

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We, JOHN THOMPSON WATER TUBE BOILERS LIMITED, a Company registered under the laws of Great Britain, of Ettingshall Engineering Works, Wolverhampton, in the County of Stafford, do hereby declare this invention to be described in the following statement:—

This invention has reference to heat exchangers and tubes therefor.

The heat exchanger to which the present invention relates is of the kind comprising a tubular element through which one fluid is passed and another fluid is passed over the tube so that heat transfer takes place from one fluid to the other through the walls of the tube. In such heat exchangers it sometimes happens that the tube leaks and the fluids mix.

It is an object of the present invention to provide a tube for heat exchangers in which the possibility of fluid leaking from within the tube to outside the tube or vice versa is substantially reduced or eliminated.

According to the present invention, a tube for use as a heat exchanger comprises an outer tube, an inner tube spaced therefrom and a helical strip between and in contact with the inner and outer tubes to form a passage communicating with the ends of the tubes.

According to another aspect of the invention a method of manufacturing a composite tube comprises fixing around an inner tube a strip of heat conducting material in the form of a helix with the convolutions spaced apart, locating an outer tube around the strip and forcing one tube towards the other tube to seal the strip against the two tubes.

According to a further aspect of the invention a heat exchanger has a tubular heat exchanging element comprising an outer tube, an inner tube spaced therefrom and a helical strip between and in contact with the inner and outer tubes to form a passage communicating with the ends of the tubes.

A composite tube according to the invention for a heat exchanger will now be described by way of example. The composite tube comprises an inner tube and a strip or wire of heat conducting material such as copper helically wound around the inner tube with the convolutions spaced apart. This tube with the surrounding strip is contained concentrically within an outer tube of such internal diameter that there is a fit between the internal surface of the outer tube and the outer surface of the strip. Thus a continuous helical passage is formed between the inner and outer tubes and which extends between and communicates with each end of the tubes.

In a heat exchanger, one fluid is passed through the inner tube and another fluid passed over the outer tube. An inert gas is passed through the helical passage between the inner and outer tubes. The inert gas is at a pressure different from the pressure of the fluid around the tube so that if by any chance there is a leakage in one of the tubes, fluid will pass into or out of the helical passage between the tubes depending upon the pressure difference and the pressure within the passage between the tubes will then be changed. This change of pressure can be detected, and hence an indication given that a leak has occurred. This leakage can be detected for example by a pressure gauge or by chemical reagent.

It will be appreciated that reinforcement

of the inner and outer tubes by the helical strip gives added strength to the tubes.

The tube may conveniently be manufactured by fixing one end of the strip to one end of an inner tube, and the strip or strips are then wound round the inner tube at the desired pitch. On completion of the required winding of the strip on the inner tube the other end of the strip is fixed to the other end of the tube. The tube and strip are then located within the outer tube and intimate contact is made between the tubes and the strip. This may be accomplished either by expanding the inner tube or drawing down the outer tube. If the inner tube is to be expanded, this may be accomplished by driving a mandrel through it or by submitting it to internal hydraulic pressure. The expansion is sufficient to ensure adequate and intimate contact between the tubes and the strip. If the outer tube is to be drawn down the tubes would be passed through a die to reduce the diameter of the outer tube, and sufficient reduction is effected to ensure adequate and intimate pressure contact between the tubes and the strip.

In an alternative method the strip could be welded as by resistance welding or soldered to both of the tubes.

It will be appreciated, of course, that before the tubes and strip are joined, they should be thoroughly cleaned, and the manufacturing operation should be carried out in an inert atmosphere to prevent formation of oxide film on the tube and on the strip.

A tube as above described would be particularly advantageous as applied to a heat exchanger in which the heating fluid is liquid metal and the heated fluid is water. The one tube would probably be of stainless steel, the strip would be of aluminium, copper or other high conductive material, and the other tube of alloy or mild steel.

It will be appreciated that a plurality of parallel strips or wires may be located between the tubes having equal spacings between the strips.

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804,592 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig. 1.

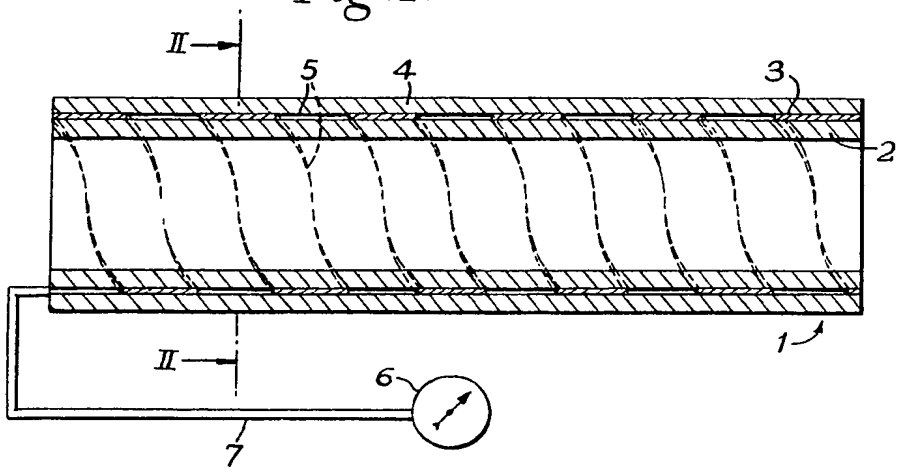

Fig. 2.

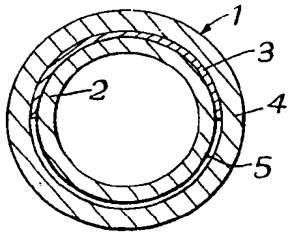

Fig. 3.